

1,091,573



# PATENT SPECIFICATION

DRAWINGS ATTACHED

1,091,573

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## COMPLETE SPECIFICATION

### Combustion Apparatus for Gas Turbine Engines

We, JOSEPH LUCAS (INDUSTRIES) LIMITED, of Great King Street, in the City of Birmingham 16, a British Company, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to combustion apparatus for gas turbine engines and of the kind comprising a plurality of flame tubes spaced angularly about the longitudinal centre line of the engine, to a first or upstream end of each of which air can be supplied from a compressor, means being provided for supplying liquid fuel to the flame tubes, and from the opposite, or downstream end of the flame tubes the products of combustion can be discharged through a turbine.

The parts of the combustion apparatus are subjected, in use, to considerable temperature changes and it has therefore been proposed to mount the flame tubes on supporting structures of the engine in such a way that stressing due to differential thermal expansion and contraction, is minimised.

The object of this invention is to provide combustion apparatus, in a convenient form, which permits of some relative movement between the flame tubes and the supporting structure, to minimise stressing.

According to the present invention, in combustion apparatus of the kind specified, each flame tube is mounted on supporting structure of the engine, at its upstream end for sliding movement longitudinally of the flame tube as well as for limited pivotal movement of the flame tube about its upstream end, the downstream end being adapted to be connected to the supporting structure by a hinge connection at its inner side with respect to the engine centre line,

[Price 4s. 6d.]

the axis of the hinge being substantially tangentially with respect to a circle the centre of which coincides with the engine centre line, and overlapping flanges on the flame tube and on the supporting structure respectively, at or near the downstream end, permitting relative movement of the flame tube and the supporting structure.

A specific example of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic view of a flame tube incorporating this invention, the view being taken on a radial plane of an engine, and

Figure 2 is a cross-sectional view on the line II-II in Figure 1.

In this example the flame tube 10 shown is one of a plurality of such flame tubes disposed equi-angularly about the engine centre line, each, at its upstream end, being arranged to receive air from a compressor (not shown) and being arranged to discharge the products of combustion from its downstream end, through an annular discharge opening 11, to a turbine (not shown).

The flame tube is mounted on the engine, at its upstream end by means of a liquid fuel burner nozzle 12 incorporating a spherical bearing 13 to permit of limited pivotal movement of the flame tube 10 about its upstream end. Further, the flame tube is slidable longitudinally, relative to the burner nozzle 12.

The downstream end of the flame tube 10 is mounted on support structure 14 of the engine to permit of expansion of the outer side of the flame tube relative to the inner side, with respect to the engine centre line.

This is achieved by the provision of a lug 15 on the flame tube inner side and a corresponding pair of lugs on the support structure, the lugs 15 on adjacent flame tubes and

- the pair of lugs 16 on the support structure being connected by a hinge pin 17, the axis of which extends generally tangentially with respect to a circle the centre of which coincides with the engine centre line, this arrangement being illustrated in Figure 2.
- The hinge pins 17 also serve to secure adjacent flame tubes 10 together. The lugs 15 on the flame tubes are disposed at their lateral and inner edges and one lug 15 on each flame tube, of an adjacent pair are together located between the pair of lugs 16 on the supporting structure, the latter also defining, in combination with the flame tube ends, the annular discharge opening 11. Thus the junctions between adjacent flame tubes 10 coincide radially of the engine with the hinge connections. The two lugs 15, one on each of the pair of adjacent flame tubes, when in assembled position, are not held tightly together but can move relatively to one another lengthwise of the hinge pin 17. Furthermore, the junctions between the flame tubes 10 and also the junctions between the flame tube downstream ends and the supporting structure 14 comprise overlapping flanges which permit relative expansion to take place, this arrangement being designated by numeral 18.
- It will be understood that the flame tube ends may be shaped to accomplish the change from circular cross-section of the flame tubes themselves to the shape of the annular discharge opening 11. The adjacent flame tube wall portions join to form a portion which is concave in as viewed a radial plane with respect to the centre line of the engine, and is convex as viewed in a plane perpendicular to said radial plane.
- Between adjacent hinge connections there are formations comprising a pair of lugs 19 on the flame tube and a single lug 20 on the support structure 14, engaged therebetween,

but permitting relative sliding movement between the flame tube and the support structure in a direction lengthwise of the engine.

#### WHAT WE CLAIM IS:—

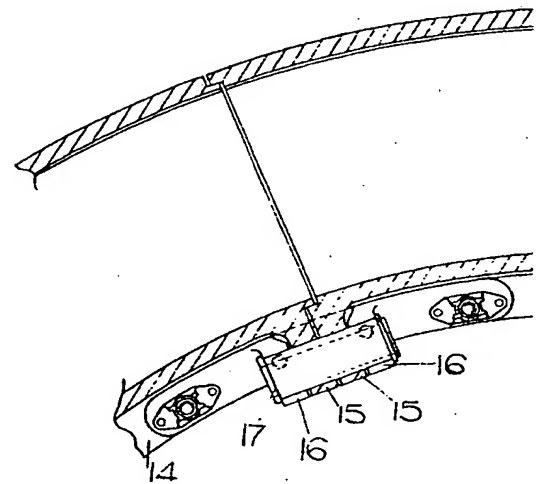
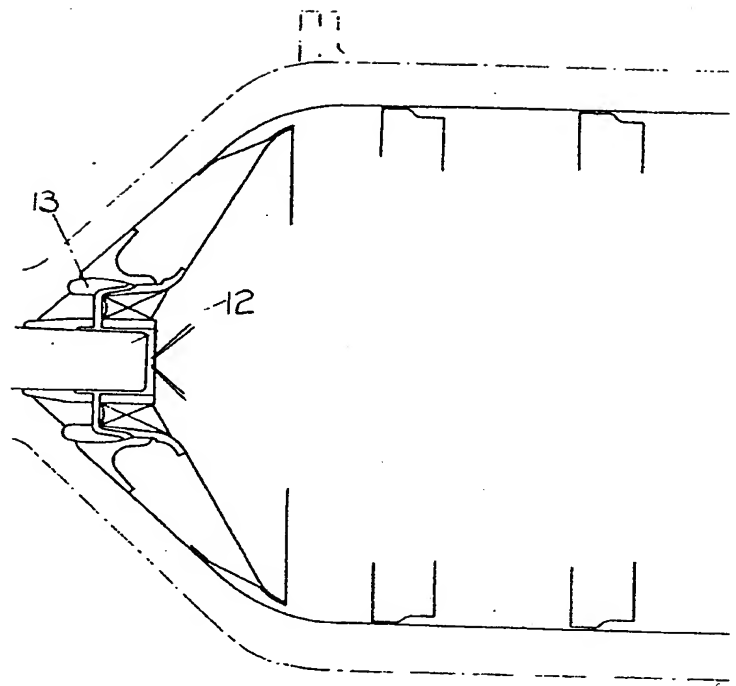
1. Combustion apparatus of the kind specified in which each flame tube is mounted on supporting structure of the engine, at its upstream end for sliding movement longitudinally of the flame tube as well as for limited pivotal movement of the flame tube about its upstream end, the downstream end being adapted to be connected to the supporting structure by a hinge connection at its inner side with respect to the engine centre line, the axis of the hinge being substantially tangentially with respect to a circle the centre of which coincides with the engine centre line, and overlapping flanges on the flame tube and on the supporting structure respectively, at or near the downstream end, permitting relative movement of the flame tube and the supporting structure.

2. Combustion apparatus according to claim 1 in which the hinges also serve to interconnect the downstream ends of adjacent flame tubes.

3. Combustion apparatus according to either of claims 1 and 2 in which there are further formations intermediate adjacent hinges, between the flame tubes and the supporting structure, these further formations permitting relative sliding movement between the flame tubes and the supporting structure in a direction lengthwise of the engine.

4. Combustion apparatus of the kind specified substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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Chartered Patent Agents,  
Agents for the Applicant(s).



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1 SHEET

## COMPLETE SPECIFICATION

**1 SHEET**

This drawing is a reproduction of the Original on a reduced scale.

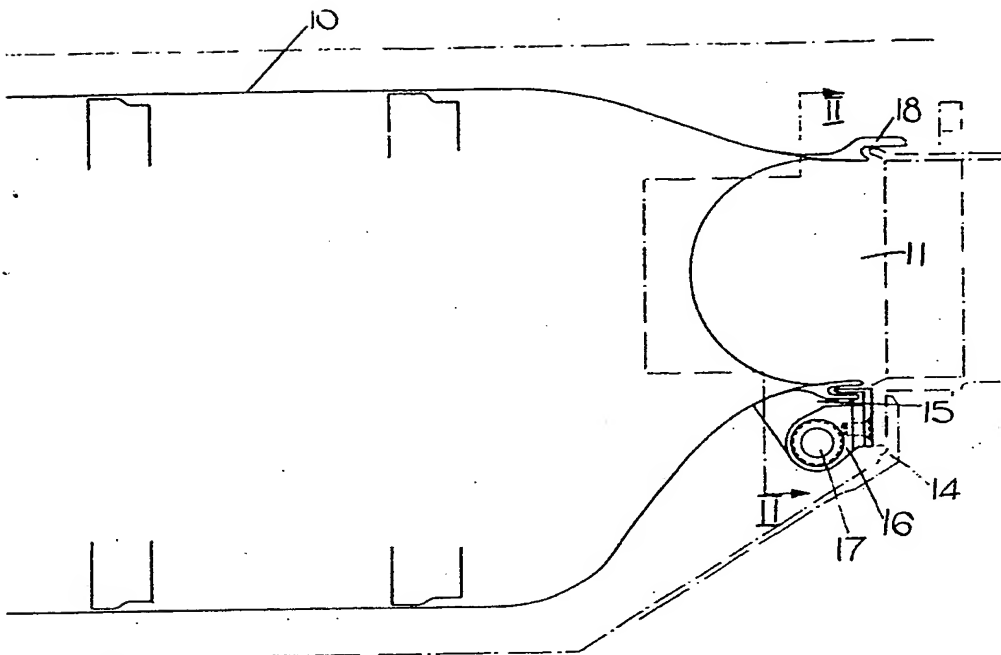


FIG. 1.

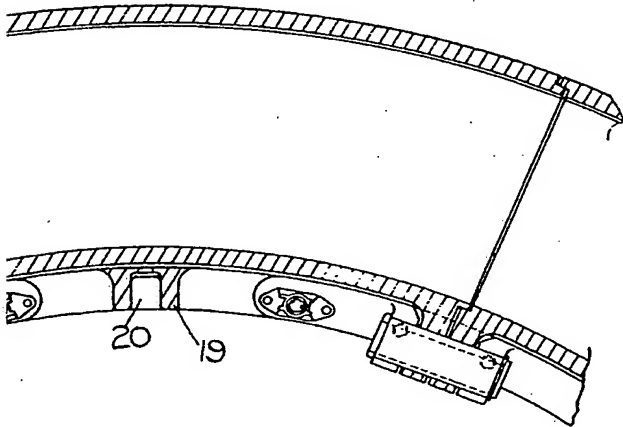


FIG 2.

